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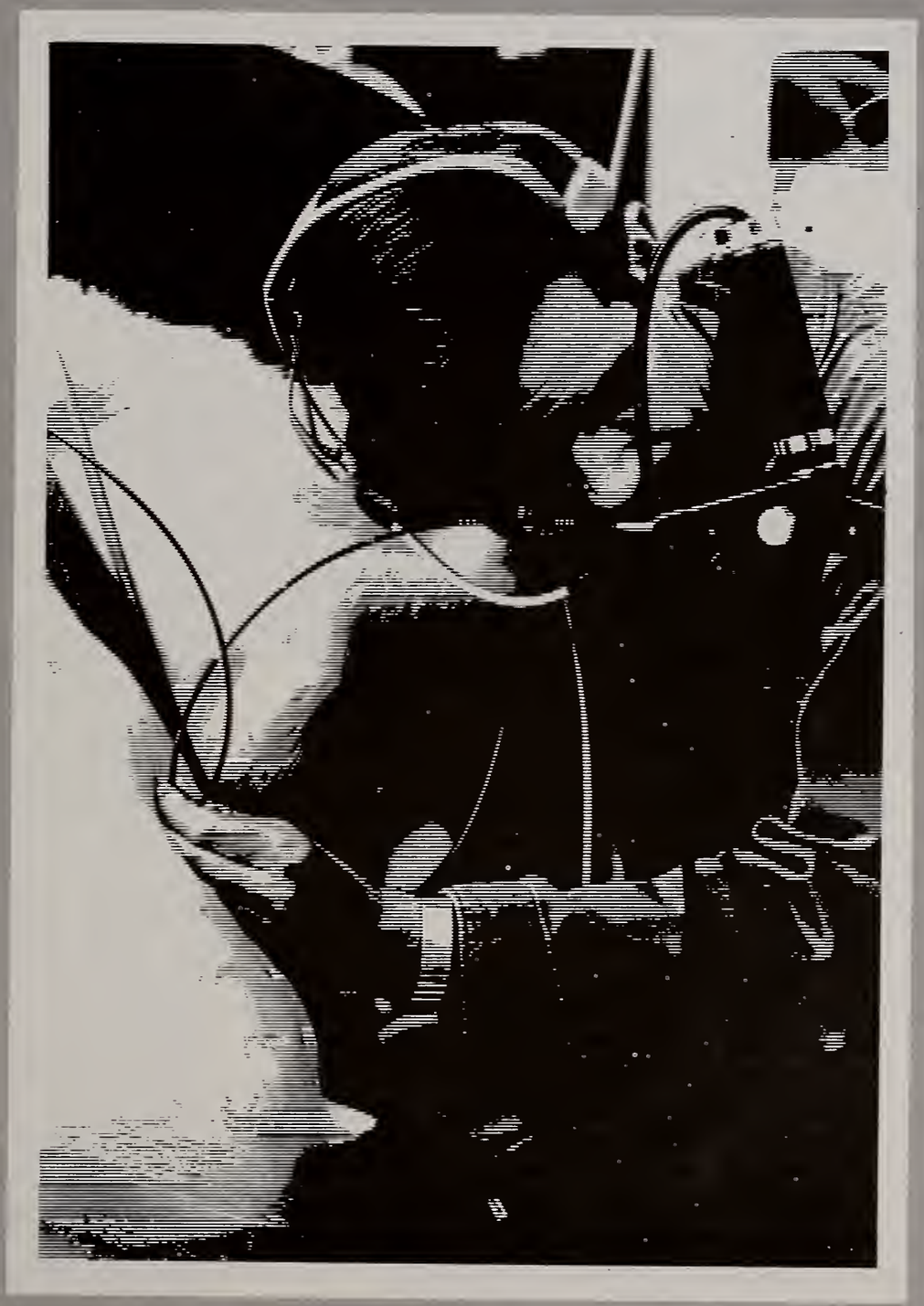

agricultural research

April 1978/Vol. 26, No. 10

Wind and Water—Softening Their Effects

BOUNDLESS ACRES of fertile valleys, virgin forests, rolling prairies, and shortgrass plains greeted the pioneers. It was an unscratched land of plenty for all.

Unlike native North American Indians, however, the settlers refused to live with the wild virgin land as they found it. They "tamed" it with axes, fire, and plows.

The original pine forests of the East were the first victims. As the plows dug into the prairie sod, the grasslands withered. Soon, erosion by water in the East was matched by erosion by wind and water in the West. Floods increased dramatically.

The most spectacular damage to our land probably occurred during the "Dust Bowl" years. From bare, abandoned land, from abused pastures, and from fields unwisely managed, there arose billowing clouds of dust that hid the midday sun.

The evidence of the destructive processes had been everywhere, but few saw it in time. Many had accepted erosion as an inevitable and uncontrollable consequence of farming.

Today we know that we can never totally stop wind and water erosion, but we have learned ways to soften their effects. Conservation research and practices have helped. Millions of acres of land were shifted from row crops to pasture. Abused and depleted ranges are returning to lush grasslands.

But the battle is not won. Some scientists estimate that we still lose more than four billion tons of U.S. soil alone to water erosion each year.

Research scientists must find new ways to stop the soil loss through wind and rain. SEA scientists are attacking the problem from many sides. Some are seeking ways to re-establish the native blue grama grass that once protected the soil of the central Great Plains. SEA scientists in California recently developed a chemical soil treatment to retard erosion (see page 6).

Erosion forced us to change our basic philosophy about the land. Our natural resources are finite and we must plan carefully how best to use them. Agricultural research can provide some of the tools to help with these difficult decisions.—*M.M.M.*

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COVER: Research on mastitis gets a new look through the use of fiber optics and a TV camera (1177B1474–6). Story begins on page 8.

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Dr. Kehr and Dr. Manglitz check individual alfalfa plants to determine the percentage resistant to pea aphids. Each flat contains six varieties of alfalfa. The row of flats in the center is used to propagate the aphids (0178X105–23A).

Multiple Pest Resistance in Alfalfa

COMPARISON OF TWO varieties released 10 years apart spotlights the progress in incorporating multiple pest resistance in alfalfa, our principal legume.

Baker, released in 1977, has high resistance to pea aphid, spotted alfalfa aphid, and bacterial wilt. It has moderate resistance to downy mildew and potato leafhopper yellowing, as well as low resistance to anthracnose. In contrast, the widely grown variety Dawson released in 1967 has a lower level of resistance than Baker to three of these pests, moderate resistance to two, and no resistance to one.

Both varieties are adapted to the North Central States and are cooperative developments of SEA and the University of Nebraska, Lincoln. Certified seed of Baker, also released by the Kansas and South Dakota Agricultural Experiment Stations, will be available for 1978 planting.

All varieties jointly released by SEA and cooperating state experiment stations since 1956 are resistant to one or more diseases or insects, says SEA agronomist William R. Kehr. SEA entomologist George R. Manglitz, university plant pathologist John E. Watkins, and university biochemist Robert L. Ogden are other members of the Lincoln alfalfa improvement team.

Some 30 diseases and nematodes and 10 insects limit alfalfa production in this country. Fortunately, not all are damaging each year, and some are problems only in limited geographic areas. Diseases and nematodes produce annual losses estimated at 25 percent of crop value, and insect losses are estimated at 15 percent of crop value. At 1975 prices, each 1 percent reduction in yield costs about $40 million, Dr. Kehr says.

Progress toward the multiple pest resistance needed in commercial varieties involves simultaneous advances in identifying sources of resistance, screening procedures to select resistant

Entomology research technician Henry Stevens (left) and plant research technician J. Russell Garl prepare a series of flats in which varieties of alfalfa will be grown and compared for aphid resistance (0178X106–4). After infestations with spotted alfalfa aphids, the flats were checked for plant growth (0178X107–18). The absence of plants in two of the rows, as noted here by Dr. Kehr and Dr. Manglitz, reveals which varieties of alfalfa were killed by the aphids.

plants, combining sources in germplasm, and breeding methods to incorporate multiple resistance and other desired agronomic characteristics in breeding lines.

Levels of disease and insect resistance adequate for economic protection are available for nine pests, Dr. Kehr says. They are anthracnose, bacterial wilt, common leafspot, downy mildew, Phytophthora root rot, rust, stem nematode, pea aphid, and spotted alfalfa aphid. In addition, moderate resistance to the alfalfa weevil and potato leafhopper yellowing is available.

Scientists have resistance screening procedures for 18 pests, also including bacterial leafspot, Fusarium root rot and wilt, Leptosphaerulina leafspot, northern root knot nematode, spring and summer blackstem, Stemphylium leafspot, and yellow leafblotch.

SEA alfalfa breeders at 11 locations concentrate on those pests of greatest importance in the geographic area they serve. Dr. Kehr, for example, is giving greater emphasis to the alfalfa weevil, new to the central plains, along with other principal pests of the area.

New alfalfa varieties have diverse parentage, Dr. Kehr points out. Baker includes germplasm from eight varieties, two related species of alfalfa, and three foreign plant introductions.

The number of alfalfa varieties has increased from only 35 in this country 10 years ago to about 140 now. "But we do not release a new variety just because it is as good as one already available," Dr. Kehr said. "It must be distinctly superior."

Baker, as an example, not only carries resistance to six pests but is a winterhardy variety of long persistence. Its forage yields were superior or equal to Dawson and Vernal in 20 tests at 13 locations, and seed yields were comparable to those of Ranger in California and Vernal in Idaho.

Alfalfa is a $4 billion crop grown for forage on 27 million acres and for seed on 425,000 acres. Increased resistance to its many pests is a key element in maintaining and expanding livestock and poultry production. And its ability to fix nitrogen from the air saves some of the fossil fuel used for manufacturing nitrogen fertilizer.

A completely pest-resistant alfalfa may never be possible. But tremendous progress has been made in the 50 years USDA has conducted alfalfa research at Lincoln.

Dr. William R. Kehr is at 333 Keim Hall, University of Nebraska, Lincoln, NE 68583.—*W.W.M.*

***Below:** Must the protein quality of alfalfa be compromised to achieve multiple pest resistant characteristics? So far, research has shown no loss in the protein value of alfalfa varieties bred for increased resistance to aphids. Here, Professor Robert L. Ogden, a biochemical engineer with the University of Nebraska at Lincoln, is determining crude protein content of alfalfa samples (0178X109–11).*

New Semi-dwarf Soybeans

CERTIFIED SOYBEAN GROWERS in Illinois and Ohio this year are growing the Midwest's first semidwarf soybean variety. This new variety, named Elf, is distinguished by its short stature and its resistance to early lodging (falling over), which often greatly reduces yields of other varieties grown on soils of above-average fertility.

Science and Education Administration agronomist Richard L. Cooper, presently at Wooster, Ohio found that, in high-yield environments at Urbana, Ill., Elf outyielded Williams soybeans by 5 bushels per acre in 30-inch rows and by 10 bushels per acre in 7-inch rows.

In regional tests conducted by agricultural experiment stations throughout the Midwest, Williams and Elf varieties produced about equal yields in 30-inch rows. Elf grew to an average height of 22 inches while Williams grew 37 inches tall.

Illinois and Ohio State Agricultural Experiment Stations cooperatively released the new variety with USDA. Several more semidwarf varieties are being developed in a breeding program begun in 1969.

Dr. Cooper began selecting crosses of soybeans for the semidwarf program because lodging in early to mid-August was a major barrier to higher soybean yields with indeterminate varieties that are grown in northern States. Indeterminate soybeans are those that continue to increase in height after flower formation is initiated. If the height increase induces lodging, the plants may undergo physiological changes that impair setting of seed and filling of pods.

To develop semidwarf soybeans for the Midwest, Dr. Cooper first crossed high-yielding indeterminate soybeans adapted to northern States with determinate soybeans adapted to the South. From the second (F_2) generations of these crosses grown at Urbana, he selected high-yielding plants that were semidwarfs and purely determinate and tested yields for two more generations (F_3 and F_4) to further identify the best lines and crosses. Then, he continued to yield test offspring of the crosses that he had identified as most promising. This process is known as early generation testing.

A superior cross of Williams x Ransom soybeans was used to develop Elf, which matures about the same time as Williams. Dr. Cooper found that 54 lines from Williams x Ransom crosses varied in dates of maturity by as much as 2 weeks. Altogether, these lines, planted in 7-inch rows, produced an average yield that was nearly 16 bushels per acre greater than the yield of Williams.

Dr. Cooper inspects a field of "Elf" soybeans. These beans have already flowered and have reached their maximum height of approximately 24 inches (0973X1463–23).

Semidwarf varieties similar to Elf may be released within the next few years. The newer variety candidates in the breeding program are presently undergoing tests on suitability to Midwest growing conditions.

USDA did not increase and distribute seeds of Elf to growers. Rather, seeds were increased by Illinois and Ohio foundation seed organizations and were then distributed to certified seed growers in the participating States. Seed is expected to be available for general farm production in 1979.

Dr. Richard L. Cooper's address is USDA-SEA, Ohio Agricultural Research and Development Center, Room 208, Williams Hall, Wooster, OH 44691.—*G.B.H.*

Cellulous Waste Products Can

SOIL EROSION IS the most expensive natural phenomenon known to man. If wind and water erode as little as $\frac{1}{10}$ inch of topsoil, representing 16 tons per acre, current replacement costs for just the three basic plant nutrients (nitrogen, phosphorus, and potassium) contained in that topsoil would exceed $28 billion annually. This is based on 360 million acres of cultivated cropland in the United States. And 30 to more than 1,000 years may be required to form 1 inch of topsoil under natural conditions.

Nutrient losses are only a small part of the damage done by erosion. Organic soil components are also removed and desirable physical properties of the soil altered. Furthermore, wind- and water-borne particles contribute to air and water pollution. Costs for controlling these problems may be prohibitively expensive.

In an effort to halt such losses, scientists at SEA's Western Regional Research Center, Berkeley, have developed an inexpensive chemical soil treatment. Cellulose, regenerated from cellulose xanthate, binds soil ingredients to retard wind and water erosion.

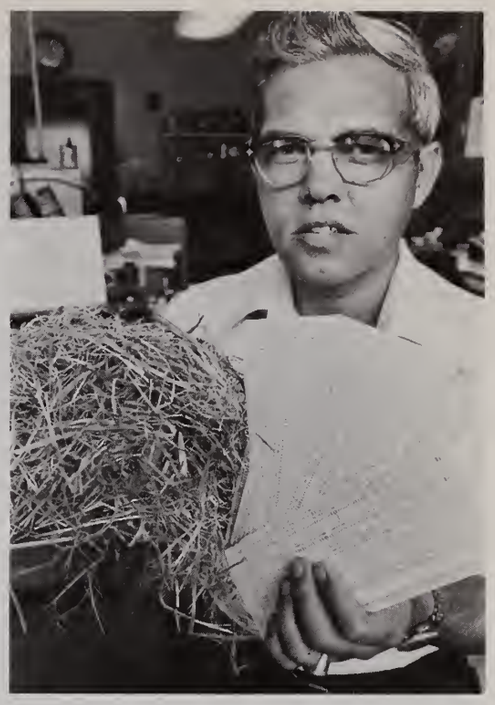
Currently-used soil amendments are manufactured from petroleum products, and the chemicals necessary for adequate soil treatment are likely to cost at least $100 per acre. Costs for materials used in the SEA-developed treatment are estimated at less than $15 per acre to achieve the same level of soil stabilization. Naturally, both these figures would be increased by the cost of application.

"An extra benefit of this process is that cellulose xanthate can be manufactured from waste cellulose sources, such as wheat or rice straw, or even used computer program cards. Since nearly any cellulosic waste that is not woody could be used, it's possible that some agricultural wastes could be disposed of in this way," says chemist Emory Menefee.

To prepare a xanthate solution, scientists soak the cellulose raw material in an 18-percent solution of sodium hydroxide (lye) for times up to an hour. Then they remove the excess sodium hydroxide solution and add car-

"Artificial gravel" is studied by Mr. Hautala (left) and Dr. Menefee. The "gravel" is actually cellulose xanthate and soil formed into clods for potential use as an envelope surrounding perforated drainage tubing to prevent clogging by fine soil particles. In these laboratory experiments artificial gravels held up well, even when submerged in water for several months (1077X1370–23A).

Halt Erosion



Right: *This simple demonstration by Dr. Menefee (left) and Mr. Hautala offers dramatic proof of the ability of cellulose xanthate to retard erosion. The left half of the test plot was treated with one-tenth of one percent cellulose xanthate in the top centimeter of soil. The right (control) side was untreated. Thirty seconds after water application, soil began to run off the untreated half while the cellulose treated portion absorbed the water (1077X1369–15A).*

Far Right: *Mr. Hautala displays fibrous rice straw, and used computer cards—two of many waste cellulose products from which cellulose xanthate can be manufactured to help check soil erosion (1077X1372–12).*

bon disulfide. After about 12 hours the cellulose is transformed into orange-colored cellulose xanthate, and it is then ready for dilution and use.

As little as 0.05 percent of cellulose in the top half inch of soil on a test plot reduced the amount of soil lost during hard spraying to less than 0.5 percent of that lost by untreated soil. The plots were prepared by sprinkling them with the equivalent of 3,000 gallons per acre of a 0.2 percent cellulose solution, and waiting until the soil had partially dried before testing.

Another application undergoing investigation is "artificial gravel" for use around drainage pipes. When these perforated pipes are laid in heavy clay, they often tend to plug with fine soil, making them inefficient and eventually useless. Burying the pipe in a gravel envelope slows the soil-filling process. However, transporting gravel to remote locations can be expensive. Onsite mixing of cellulose xanthate with soils may provide a cheap gravel substitute. In the lab these artificial gravels have held up well, even after having been immersed in water for several months.

"Currently we are seeking methods to make the xanthate more stable. After storage for more than 3 days the solution turns to a gel that can't be sprayed on soil. It can be stored for longer times when frozen or refrigerated, but we want to eliminate additional expensive equipment," says chemist Earl Hautala at the Center.

Dr. Emory Menefee and Mr. Earl Hautala are at USDA's Western Regional Research Center, 800 Buchanan Street, Berkeley, CA 94710.—*D.H.S.*

Successful Control of Khapra Beetle

TWO PESTICIDES, Gardona and Fenitrothion—tested in Pakistan—are particularly effective against the khapra beetle, a pest of stored grains.

Applied to wheat at 5 parts per million (ppm), Gardona effectively killed larvae for 50 days after treatment when residues were 0.7 ppm or less. Ten days later, or within 60 days of application, all residues disappeared from the grain.

Fenitrothion applied to stored wheat at the rate of 8 ppm controlled khapra beetle larvae for 15 to 18 months. It persisted longer and killed larvae faster than any of the other six pesticides and combinations of pesticides tested.

SEA-cooperating scientist Lee A. Bulla, Jr., Manhattan, Kansas, says tests of this nature for the control of the khapra beetle cannot be conducted in the United States because of the quarantine of that insect.

Dr. Bulla says, "The beetle invaded parts of southwestern United States and Mexico in the 1950's. It was eradicated, but at considerable cost. U.S. trade with the Mideast is increasing, and more interceptions were reported last year (146) than in 1976 when 133 interceptions were made at U.S. ports. The findings of this research can also be used to control dermestid beetle species—other than khapra—which could infest grain in this country."

The Pakistani project was conducted under the direction of Heshamul Huque at the Ministry of Agriculture and Works, Karachi.

Dr. Lee A. Bulla, Jr. is with the U.S. Grain Marketing Research Laboratory, 1515 College Avenue, Manhattan, KS 66502.—*M.C.G.*

Right: Lights, camera, action! Dr. Thompson adjusts the connection between his video camera lens and the fiber optic cable which carries light into the udder of the cow. The same cable will carry an image of the milking action back to the camera which relays it to a television monitor (right, foreground). Engineering technician John Sauls and student Kathy Lehman stand by to assist while research reporter Mary Ellen Nicholas (background) observes the operation (1177B1474–5).

Below: The inside of a cow's teat during milking action, as seen on a TV monitor. The image is simultaneously video-taped for future evaluation (1177B1474–13A).

Fiber Optics, TV Used to Study C

The catheter to follow these guidewires will supply the teat with sterile water—thereby enabling the milking action inside the teat to be visible on a television screen (1177B1471–25).

A NEW EXPERIMENTAL technique using fiber optics allows scientists to look inside a cow's teat and observe what happens to the teat when a cow is milked. The technique is relatively simple and could help scientists design new milking machines to milk cows faster with less stress on the teats. Improper use of milking machines can be a factor in mastitis. Mastitis is the most serious disease of dairy cattle, causing millions of dollars in lost milk production every year.

At the Beltsville Agricultural Research Center in Maryland, SEA biomedical engineer Paul Thompson inserts a fiber optic catheter into the teat

ows' Teats

Above: In order to televise the inside of a cow's teat, the teat itself must be clear of all milk. In this preliminary stage of the procedure, Dr. Thompson withdraws milk from the catheter pathway inside the teat (1177B1472–19A).

Left: SEA veterinarian Ben Stroud prepares a tranquilizer that will keep the cow calm for approximately 1 hour—the time necessary to complete the operation (1177B1472–24A).

by passing the catheter through a needle puncture in the cow's udder. The catheter transmits an image to a television screen. A video tape records the image for later study. Milk in the udder is replaced with sterile water so that a clear image is visible.

By observing the action of the teat during milking, Dr. Thompson hopes to be able to develop new milking machines and to spot potential trouble with present milking machines.

Dr. Paul Thompson's address is Genetics and Management Laboratory, Building 173. Beltsville Agricultural Research Center-East. Beltsville, MD 20705.—*M.E.N.*

More Corn from the Cob

PROCESSING OF CUT or "whole" kernel sweet corn creates one of the greatest sources of organic waste in the vegetable processing industry. Such wastes, if not properly treated before leaving processing plants, can seriously pollute rivers, lakes, and streams. Treatment costs are expensive—adding to the price consumers must pay for canned and frozen corn. Furthermore, these wastes (as in most vegetable processes) represent loss of flavor, nutrients, and yield.

Researchers at SEA's Western Regional Research Center in Berkeley have designed new equipment and techniques for kernel removal to reduce organic wastes created during processing by up to 80 percent.

Sweet corn kernels are normally cut from cobs. This opens up the tip of each kernel, allowing a portion of the interior to leach into processing waters during subsequent handling.

The SEA-designed machinery removes kernels without cutting. Kernels are pushed off, intact, thus eliminating the leaching experienced with conventional techniques.

Because whole kernels are removed intact, each ear produces up to 20 percent more edible corn. Current cutting techniques can leave as much as half of each kernel on cobs, which are then sold as cattle feed.

To prepare ears for processing, husks are removed, then ears are split lengthwise. Splitting opens each ear so that the machinery can push kernels off, starting at the split edge.

Next, ears are held against a rotating drum which has a smooth rubber surface to rub off loose kernels. Ears are slowly rotated while being pushed against the drum. A small stream of water is directed against the drum surface to clean away juices formed during contact with the corn. Also, air heated to approximately 117° to 232° C. (350° to 450° F.) is blown on the surface to

Above: These intact kernels bear mute testimony to the efficiency of the SEA-designed corn processing system (1077X1366–31A).
***Right:** In the new process, split ears are rotated while being pushed against the revolving drum. Rubbing action removes the kernels intact (1077X1366–19A).*
***Far Right:** How much force is necessary to remove an intact kernel from the cob? Dr. Robertson uses this specially designed machine to identify those corn varieties which hold their kernels less tightly (1077X1368–13).*

evaporate cleaning water and thus maintain the friction needed for kernel removal.

Other surfaces on the drum can also be used to remove kernels. These include surfaces with rubber "fingers" or studs and surfaces similar to a washboard with small motorized rollers.

"Although this is only pilot-scaled equipment, minor modifications would enable it to handle the volume of a typical processing plant," says SEA chemical engineer Melvin E. Lazar.

Three varieties of sweet corn were used in these studies. Two were representative commercial varieties commonly grown in the Northwest for canning and freezing. The third was an experimental glumeless variety. Glumes on corn add fiber to the final product unless removed during processing. The experimental variety also had kernels that were held less tightly to cobs than the commercial varieties.

"There may be a need to develop a new variety of sweet corn that separates more easily from cobs. However, we will continue machine modifications to help avoid this need," says chemical engineer George H. Robertson.

Taste panels report that frozen corn prepared by the SEA-method had a flavor nearly equal to corn-on-the-cob and that the panels preferred this corn to conventional whole kernel corn.

Cooperators on this project include the Environmental Protection Agency and the American Frozen Food Institute.

Mr. Lazar and Dr. Robertson are at the Western Regional Research Center, 800 Buchanan Street, Berkeley, CA 94710—*D.H.S.*

New. . . Manmade Minihive

NEW, SMALL, INEXPENSIVE beehives made from foam-plastic picnic coolers could prove useful to beekeepers, researchers, and teachers knowledgeable in bee lore.

The mini-hives are constructed from 700-cubic-inch foam-plastic boxes selling at retail stores for around a dollar. The plastic box has a built-in recession that acts as a comb support for seven "top bars." Top bars in the mini-hive are where the bee colony builds its cells to form combs.

SEA entomologist Gordon D. Waller, Tucson, Ariz., noting a need for an inexpensive hive from which queens could be naturally mated, developed the foam-plastic hive after testing other materials.

He says that the hive has proven useful in mating queens, teaching the fundamentals of bee biology to beginners (he is an assistant professor at the University of Arizona), experimenting with insecticides where a disposable hive is desirable, and for pollination under confined conditions such as field cages and greenhouses.

Dr. Waller says that beekeepers may also find the mini-hives useful as disposable pollination units for backyard fruit trees. As such they could function as small units and not tie up regular large bee colonies.

Often when small spaces like greenhouses and field cages need pollinators, large colonies are moved in. Such colonies are often too populous for the available forage, and considerable attention is required to avoid colony deterioration. Mini-hives provisioned with water, sirup, and pollen can be hung in a convenient place out of the way of greenhouse workers.

Not much effort is needed to modify the boxes for use as hives. Dr. Waller cut a 1-inch hole at the bottom for an entrance and another at the top for ventilation. He then painted the inside of the box black, inserted top bars made from ¾-inch cove molding and installed "about ½ pound of bees." He then added a laying queen—or a virgin queen about to emerge from her cell—and he was in business.

A space between the top bars and the lid of the hive is roomy enough for water, sugar sirup, pollen, or all three.

Dr. Gordon D. Waller is at the Bee Research Laboratory, 2000 E. Allen Road, Tucson, AZ 85719.—*J.P.D.*

Fungus-resistant Alfalfa Possible

DEVELOPMENT OF A technique for inoculating alfalfa with the Fusarium wilt fungus has opened the door for breeding varieties with improved resistance to the disease. No highly resistant varieties are available now.

A field test of 12 commercial and experimental alfalfa varieties demonstrated that the new technique provides a practical method for evaluating Fusarium wilt resistance, plant pathologist Fred I. Frosheiser says.

Dr. Frosheiser, working at St. Paul, Minn., with plant geneticist Donald K. Barnes, said "large differences in disease severity among the varieties tested suggests that resistance to Fusarium wilt is an inherited characteristic. This means that the resistant genes are there, and we should be able to breed for resistance."

The range of Fusarium wilt damage, by percentage of dead plants, was 76 percent for the most susceptible variety to 3 percent for the most resistant.

The researchers prepared three isolates of Fusarium inoculum from diseased alfalfa roots collected in Minnesota. They increased each isolate individually by adding a few infested soil particles to a sterile nutrient broth and incubating it on a shaker for 5 days. The three isolates were then combined and diluted.

After 10 weeks of growth in the greenhouse, alfalfa seedlings were removed from their sand benches, washed, and immersed in the inoculum for 20 to 30 minutes. The researchers clipped the tops to within 4 cm of the crown and the rots to about 12 cm before transplanting them in the field.

"We checked the plants periodically during the growing season and lifted them in September," Dr. Frosheiser said. "We sectioned each tap root and rated it for wilt. When we compared the field results and the results previously obtained in greenhouse tests, we found little difference."

The procedures appear practical for use in large-scale breeding work for development of resistant cultivars. "Our selection program has been successful in increasing the level of Fusarium wilt resistance," Dr. Frosheiser said.

Some commercial alfalfa breeders are already using the new technique he said.

By adding Fusarium wilt resistance to alfalfa cultivars carrying resistance to the other root and crown pathogens, it should be possible to increase stand productivity and longevity in many areas of the United States, he said.

"Variability in pathogenicity of the fungus has not been thoroughly investigated, and it is possible that isolates from other areas could differ in pathogenicity. Until more is known about the wilt causing Fusarium strains, cultivars being developed for specific areas should be screened against cultures of the fungus from those areas," Dr. Frosheiser said.

Varieties resistant to anthracnose, Phytophthora root rot and bacterial wilt are included in the test. The results indicated the level of Fusarium wilt resistance was not associated with the level of resistance to the other diseases. This suggests that the mechanisms of resistance are different, Dr. Frosheiser said.

External symptoms of the disease are rapid wilting of some or all of the stems. Wilting may be accompanied with yellowing or reddening of the foliage. The plants eventually die.

The disease usually progresses slowly in natural alfalfa stands, and only scattered plants show symptoms at any one time. However, considerable stand losses may occur over a period of several years. The disease occurs in most areas of the United States, but it is most severe in southern areas.

Dr. Fred I. Frosheiser, research plant pathologist, is located at Room 101, Crops Research Building, University of Minnesota, St. Paul, MN 55108.—*R.G.P.*

2, 4-D Drift Harms Sugar Beets

THE MOST WIDELY used herbicide for corn and small grains, 2,4-D, can significantly reduce sucrose (sugar) yield from sugar beets if the chemical, while being applied to other crops, accidently drifts through the air and settles on beets.

"Our studies indicate that special care must be exercised when 2,4-D is applied to crops adjacent to sugar beets. The best way to avoid damage is to apply the amine salt of 2,4-D with ground equipment when winds are less than 1 mile per hour," says plant physiologist Edward E. Schweitzer.

Many factors affect the extent of chemical drift. Those that reduce the risk include: large droplet size; close-to-ground application; maximum distance of beets from crops being sprayed; calm days; and young beets.

Schweizer, at SEA's Crops Research Laboratory, Ft. Collins, discovered that if as little as 1 ounce per acre of 2,4-D were to drift onto sugar beets during application to corn or small grains, recoverable sugar from beets is decreased 13.2 percent. Drift of ½ ounce per acre would decrease recoverable sugar by 7.8 percent and ¼ ounce would reduce sugar by 6.8 percent.

If only 3 percent of an eight ounce per acre application of 2,4-D applied to an adjacent crop were to drift on to the nearby sugar beets, that amount of drift would be ¼ ounce per acre, and would cause a loss of 6.8 percent in recoverable sugar.

Dr. Edward E. Schweizer is at SEA Crops Research Laboratory, Colorado State University, Fort Collins, CO 80523.—*D.H.S.*

Oh Elisa!

ELISA, a virus detection technique, is 100 times more sensitive for detecting tomato ringspot virus in red raspberry plants than any detection technique previously used. ELISA stands for enzyme-lined immunosorbent assay. Adapted for raspberry plants by SEA plant pathologist Richard H. Converse, Corvallis, Ore., the new technique makes possible for the first time the testing of dormant raspberry planting stock for tomato ringspot virus before the stock is dug and distributed for new plantings.

Current tests for tomato ringspot virus in raspberries, in addition to being far less sensitive than ELISA, can be run only during the spring when plant growth is young, and these tests take several days to complete. Infected plants are often overlooked entirely or not examined before summer sets in and hot weather renders the virus undetectable. The ELISA technique can be run in less than one day and—because plants are evaluated in the fall—gives plenty of advanced warning of the virus presence.

Converse first used ELISA on red raspberry plants because of the serious threat posed to the crop by tomato ringspot virus. In the Pacific Northwest, for example, over 10 percent of all red raspberry fields suffer outbreaks and, once a field becomes infected, the grower can expect anything from a 50 percent loss in yield to a total loss of the crop. Since there is no commercial cure for the disease in raspberries, emphasis is placed on prevention.

Growers prevent tomato ringspot virus outbreaks by treating their soil against dagger nematodes which carry the virus, and by purchasing raspberry nursery stock that is certified by state regulatory officials to be essentially free of viruses. ELISA will greatly aid nurseries from unwittingly passing along infected stock and will also help government regulatory agencies monitor fields for the virus' presence.

ELISA was first used in human medicine and is currently being used to study such viral diseases as the mysterious Legionnaire's Disease. Its potential for application in agriculture is widespread. Says Converse, "What's being seen in raspberries will work with apples, peaches, potatoes, soybeans and other major fruit and seed crops. ELISA, in fact is an excellent tool for detecting many viruses in clonal stocks and seeds."

Converse plans to next test the ELISA technique on other small fruits such as strawberries. He feels that ELISA may open many new opportunities for understanding and controlling plant viruses by determining their distribution in hosts and also by determining their relationships among various viruses.

Richard H. Converse is at Cordley Hall, Room 1057, Oregon State University, Corvallis, OR 97331.—*L.C.Y.*

The seeds that came in from the cold: Dr. Stanwood pulls seed samples from a tank of liquid nitrogen where they had been stored at —196° C. for 6 months. The seeds are held in plastic vials inside aluminum canisters designed specifically for liquid nitrogen freezing. Holes in the canisters allow the nitrogen to flow past the vials for maximum cooling efficiency. In addition to testing these seeds for retained germination potential, scientists will grow some of them into fully mature plants to determine if any genetic changes were caused by cryogenic storage (0178X059–34).

Ice Cold Germplasm

LONG-TERM STUDIES are currently underway for preserving plant germplasm by freezing at an ultracold temperature of −196° C. (approximately −321° F.). This cryogenic storage may enable scientists to store seed germplasm for indefinite periods of time.

In experiments conducted at SEA's National Seed Storage Laboratory, Fort Collins, Colo., seeds of 45 crops were exposed to liquid nitrogen for up to 180 days. Results indicate that there is no decline in germination of seeds of most crops as a result of such freezing.

"These results are significant since it has been demonstrated in other biological tissues that damage occurs during the freezing and thawing processes, but not while being held at the ultracold temperature. This could lead to a better method of seed storage," says SEA agronomist Phillip C. Stanwood.

Long-term preservation of seed germplasm is necessary to assure the availability of plant genetic resources for future generations. Using conventional storage techniques, seeds deteriorate and eventually die. Although seeds can be reproduced periodically to replenish diminishing supplies, seed increase processes can cause shifts in the genetic makeup. Also, increasing seed supplies is very costly.

Mr. Phillip C. Stanwood is with the National Seed Storage Laboratory, Colorado State University, Fort Collins, CO 80523.—*D.H.S.*

AGRISEARCH NOTES

Bug Resistant Cotton Ahead?

A COTTON STRAIN with good resistance to the tarnished plant bug has been discovered. Moreover, the resistance can easily be transferred to commercial varieties by plant breeders, according to SEA geneticist Johnie N. Jenkins.

"It appears that we have good material and commercial plant breeders should be able to increase resistance to tarnished plant bugs in commercial varieties of cotton," said Jenkins. "This would reduce dependence on insecticides early in the growing season and thereby conserve beneficial insects to help later when bollworms and budworms become a problem."

This could result in an environmental benefit by reducing insecticides at the beginning and end of the cotton growing season. The farmer would thus benefit by the improved control of the bollworm and budworm as well as the resistance to the tarnished plant bug.

Ms. Johnie N. Jenkins is at the Boll Weevil Research Laboratory, P.O. Box 5367, Mississippi State, MS 39762.—*B.D.C.*

Sterile Moths Reduce Insecticides

THE STERILE MALE technique, widely used to control screwworms in the Southwest, shows real potential as a way to control insects that infest stored food products while reducing applications of chemical insecticides.

In a laboratory study at the Stored-Product Insects Research and Development Laboratory, SEA entomologist John H. Brower has shown that by irradiating 1-day-old Indian meal moths

their fertility can be reduced drastically.

Dr. Brower said the study showed that both male and female Indian meal moths irradiated as adults have an adequate level of sexual competitiveness to be effective in a sterile-insect release program.

Although fully sterilizing doses of irradiation (50 kilorad for 1 hour) were debilitating to the extent that both males and females lost a measure of sexual competitiveness, Dr. Brower said substerilizing doses (35 kilorad for 1 hour) reduced fertility enough so they should prove useful in greatly reducing unirradiated populations when used in ratios of about 15 to 1, irradiated to unirradiated moths.

Dr. John H. Brower's address is Stored Products Insects Research and Development Laboratory, 3401 Erwin Avenue, P.O. Box 5125, Savannah, GA 31403.—*V.R.B.*

Poultry Wastes—Nitrogen for Cows

A NEW SOURCE of dietary nitrogen for lactating dairy cattle may have been found in dehydrated poultry excreta. Research has shown that cows fed diets supplemented with dehydrated poultry excreta consumed about the same amount of feed but gave slightly more milk than cows fed diets supplemented with urea. Dried poultry manure is not registered for commercial use by the Food and Drug Administration.

Dr. C. C. Calvert, Beltsville Agricultural Research Center, and Dr. R. L. King, University of Maryland, conducted tests in which groups of six Holstein cows were each fed one of four diets.

All four diets consisted of a corn-soybean meal concentrate supplemented with one of the following: 2 percent urea, 17.2 percent dehydrated poultry excreta, 26 percent dehydrated poultry excreta, or additional soybean meal. All diets contained 24 percent crude protein. The concentrates were mixed with corn silage; concentrates and silage each provided 50 percent of the dry matter in the diet.

Cows on all four diets consumed about the same amount of feed; however, cows on the 17.2 percent dehydrated poultry excreta supplemented diet produced 8 percent more milk than cows on the urea supplemented diet and 7 percent more milk than cows on the 26 percent dehydrated poultry excreta or soybean meal diet.

Costs of the concentrates per metric ton were $133 for the urea supplemented diet, $125 and $119, respectively, for the 17.2 and 26 percent dehydrated poultry excreta diets, and $137 for the soybean meal diet. Based on cost of concentrate per kilogram of milk produced, the dehydrated poultry excreta diets were about 11 percent less expensive than either of the other two supplemented diets.

Dr. C. C. Calvert is with the Feed Energy Conservation Laboratory, Beltsville Agricultural Research Center, Beltsville, MD 20705. Dr. R. L. King is at the Dairy Science Department, University of Maryland, College Park, MD 20742.—*M.A.M.*

A Rose by Any Other Smell . . .

PLANT BREEDERS DEPENDING upon honey bees to help cross various plant lines to produce hybrids must concern themselves with retaining "normal" aroma for that particular flower.

SEA scientists at the Bee Research Laboratory have found that a bee will "buzz off" the instant it detects an unfamiliar odor on a familiar flower.

Honey bees respond to signals they receive from their surroundings. The responses are both instinctive and learned, says SEA entomologist Gordon D. Waller. Those signals are of particular interest to scientists trying to understand and perhaps modify bee foraging behavior.

Dr. Waller, using an artificial flower, studied bee responses to chemicals found in nectar and learned that the bees either accept or reject the host plant as a source of food by that response. Among other things, the entomologist learned about the relative sweetness (to bees) of the three component sugars (sucrose, fructose, and glucose) in nectar, the preferred concentration of sugar solutions, the effect of salts, and the effect of varying pH levels.

The ersatz flower was modified to provide an odor, in addition to a sugar reward.

Honey bees have a remarkable ability to detect small amounts of chemicals identified from alfalfa flower aroma, SEA plant physiologist Dr. Gerald Loper says. When previous conditioning has taught them to associate one such chemical with the sugar sirup reward, the foraging bee is attracted to the artificial flower like a piece of metal to a magnet. Similarly, field bees trained by nature to the odor of "normal" alfalfa flowers are repelled by the odor of other alfalfa plants if they are very different.

Dr. Gordon Waller and Dr. Gerald Loper are at the Bee Research Laboratory, 2000 East Allen Road, Tucson, AZ 85719.—*J.P.D.*

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Better Use of Acetic Acid

WEIGHT GAINS IN cattle on high forage diets can be increased by improving the utilization of acetic acid. Research indicates that more efficient use of acetic acid can result from infusing glucose into the fourth or true digestive stomach (abomasum) of cattle on high forage diets.

Dr. Henry F. Tyrrell has been studying forage diets and the absorption of acetic acid by cattle on those diets.

Previous research has shown that cattle utilize acetic acid, a major end product of digestion, more efficiently when it is part of a grain diet, than when it is part of a forage diet.

Cattle on forage diets absorb a higher proportion of energy as acetic acid, but apparently the acetic acid cannot be utilized as well, limiting the rate at which cattle gain weight. Scientists believe that some factor in grain improves acetic acid utilization, and they are now looking for that factor.

Dr. Tyrrell infused six yearling Holstein heifers on a high forage diet with either acetic acid or glucose. There was little utilization of metabolizable energy (ME) from the acetic acid, but 60 percent of the ME of the glucose was used. When he infused the acetic acid and glucose together, the ME from the mixture was used as efficiently as was glucose alone, indicating that it is the glucose that is necessary for efficient use of acetic acid. In fact, a small amount of glucose added to the diet produced changes similar to those that would have been produced from a large amount of grain.

Although glucose cannot be fed directly to cattle, they are able to synthesize it from substances called glucogenic precursors. Increasing the amount of glucogenic precursors in the diet may help cattle utilize acetic acid more efficiently.

Dr. Henry F. Tyrrell is with the Ruminant Nutrition Laboratory, Beltsville Agricultural Research Center, Beltsville, MD 20705.—*M.A.M.*

Roots Through Glass Boxes

THE TOPS HAVE always been there to look at, but the bottoms have been covered.

That's been the case with plants from time immemorial, but no longer, according to SEA soil scientists William E. Lonkerd and Joe T. Ritchie. They designed and built a system of glass observation boxes to observe the root systems of plants and correlate observations with those of plant tops.

Plant roots and tops grow in dynamic equilibrium with each other, and when one part gets inadequate materials for growth, the other part is adversely affected.

Up until now, root growth has been generally inferred from some aspect of top growth. This second-hand observation makes it difficult to determine specific reasons why soil treatments, management practices, or genetic differences cause differences in top growth.

The root observation boxes were designed to help solve the problem. The system consists of four independent glass boxes, sloped 5 degrees from horizontal. A single plant is started in a solution and placed with roots divided into the four soil-containing compartments. The plant is suspended on a small central platform.

Since nearly all the roots are visible. and since they branch in near-normal patterns, the scientists can gain information on how different conditions in the root zone affect root growth, water uptake, and top growth.

The scientists now plan studies of the effects of soil water, nutrients, and aeration. Dr. Joe T. Ritchie and Mr. William E. Lonkerd are with the Grassland-Forage Research Center, P.O. Box 748, Temple, TX 76501.—*B.D.C.*

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